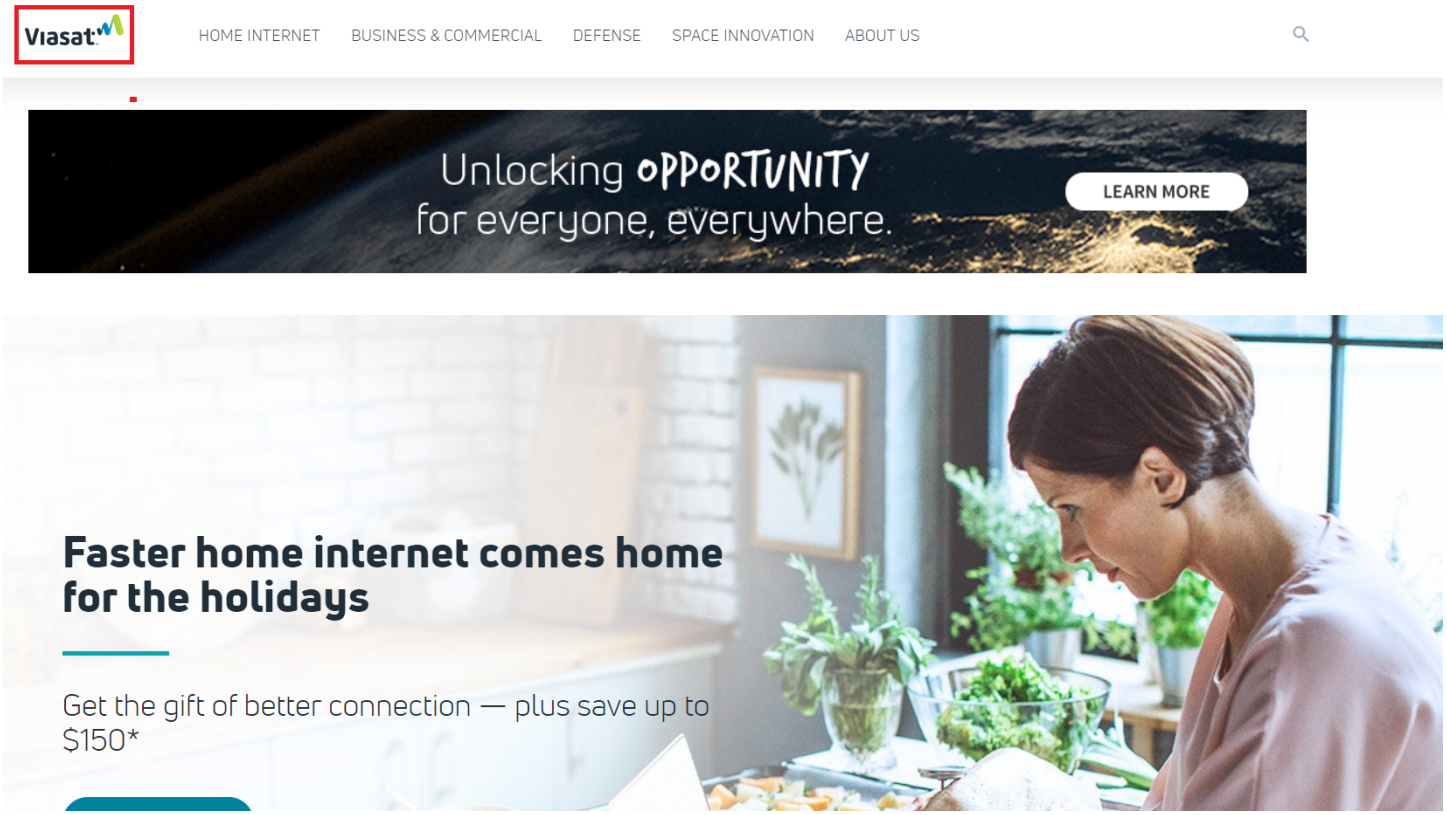
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
1. A method comprising: mapping, with at least one processor, each of a plurality of data streams related to a specific content to a different component of a service delivering multiple versions of the specific content;	The defendant streams videos making use of HTTP live streaming (HLS) standard (hereinafter referred to as the standard).  https://www.viasat.com

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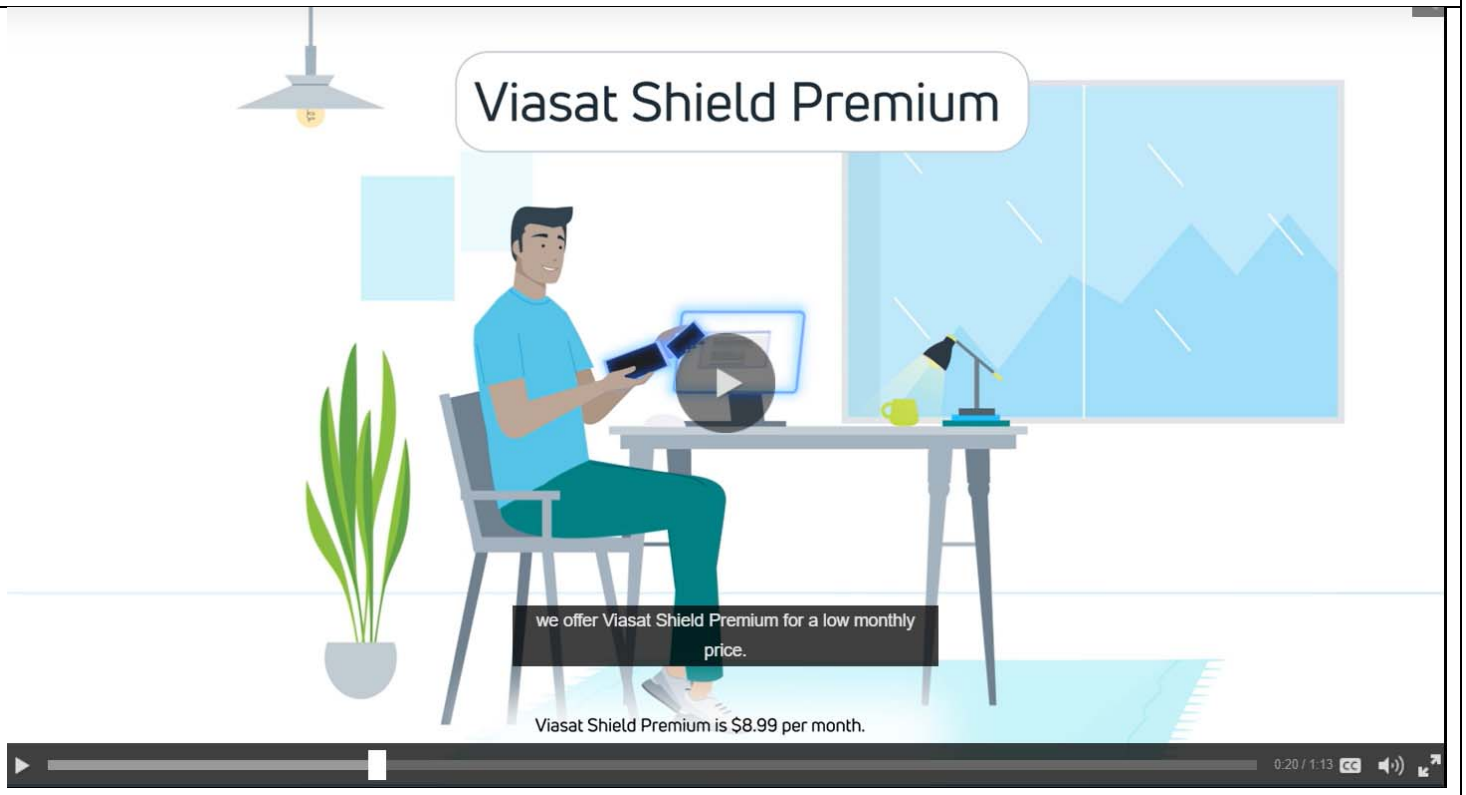
Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	 https://www.viasat.com/home-internet/additional-services/viasat-shield/ The accused standard discloses a method which comprises mapping, with at least one processor (e.g., processor/transcoder of a server of an HLS service provider), each of a plurality of data streams (e.g., media streams such as audio, video, captions, etc.) related to a specific content (e.g., streaming content such as web streaming) to a different component (e.g., Index file m3u8) of a service (e.g., web streaming) delivering multiple versions (e.g., M3U8 Manifest File comprises multiple versions of a data stream) of the specific content (e.g., streaming content such as web streaming).

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Preliminary charts based on best available information

7,848,328	**ViaSat ("Accused Instrumentality")**
	As shown below, a server of an HLS service provider converts plurality of data streams such as audio, video, etc. of a streaming content (e.g., specific content) in multiple streams at different bitrates and resolutions in different media segments of a M3U8 Manifest File. For example a media segment may consist of representation of videos and audios. Similarly, different media segments contain many different representations.

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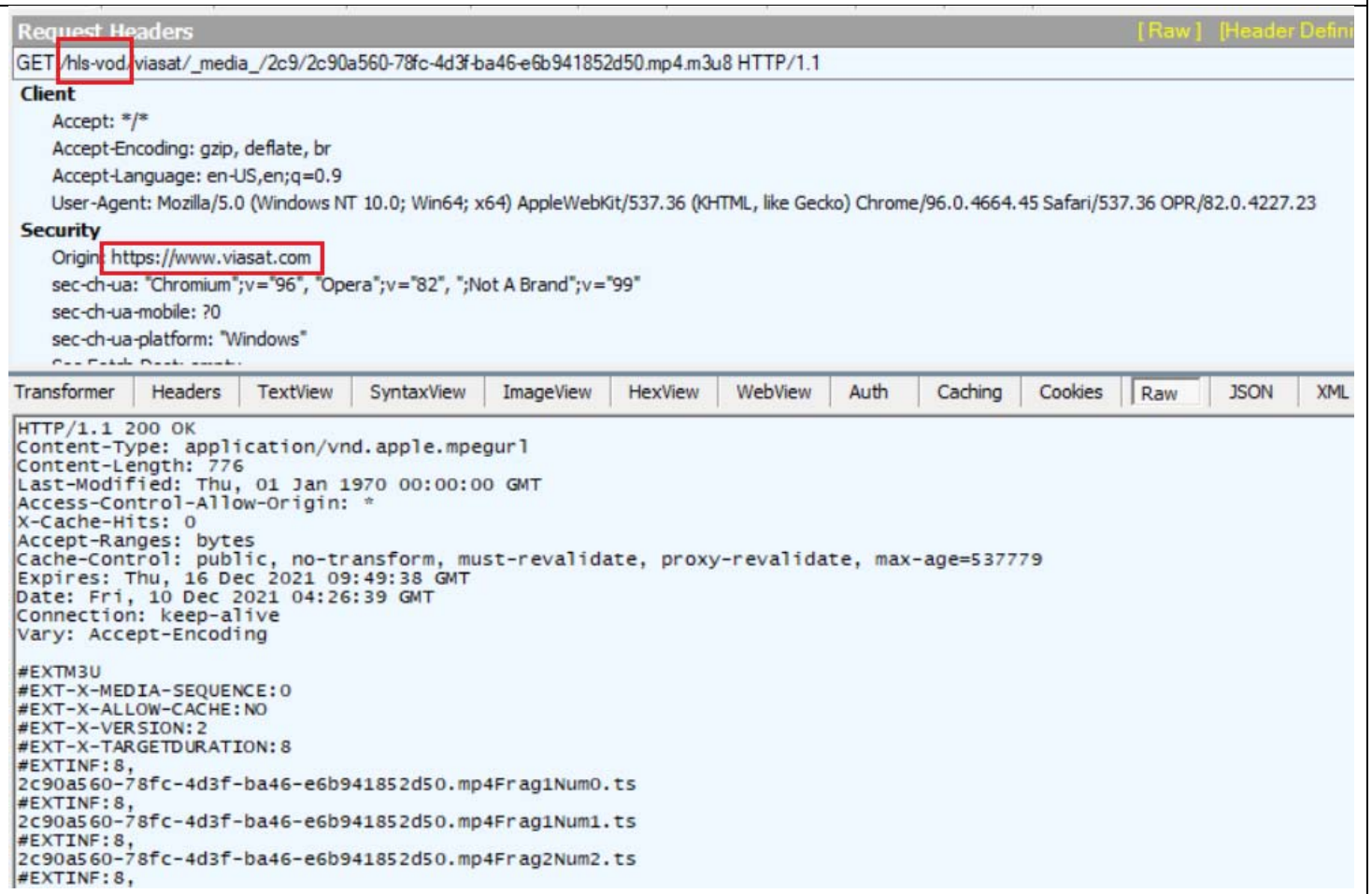
7,848,328	ViaSat ("Accused Instrumentality")



Source: Packet capture by Fiddler tool

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Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	As shown below, a server of an HLS streaming service provider converts plurality of data streams such as audio, video, etc. of a streaming content (e.g., specific content) such as an ondemand service video in multiple versions in different adaptation sets of a M3U8 Manifest File. For example, an adaption set may consist of representation of different resolutions 1920x1080 video, 426x240 video, etc. Request Headers [Raw] [Header De GET /is/content/viasat/1427614-%20Shield%20Premium%20with%20Antivirus%20GTM_final_v1-AVS.m3u8 HTTP/1.1 **Client** Accept: */* Accept-Encoding: gzip, deflate, br Accept-Language: en-US,en;q=0.9 User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/96.0.4664.45 Safari/537.36 OPR/82.0.4227.23 **Security** Origin: https://www.viasat.com sec-ch-ua: "Chromium";v="96", "Opera";v="82", ";Not A Brand";v="99" sec-ch-ua-mobile: ?0 sec-ch-ua-platform: "Windows" Sec-Fetch-Dest: empty Sec-Fetch-Mode: cors *Source: Packet capture by Fiddler tool*

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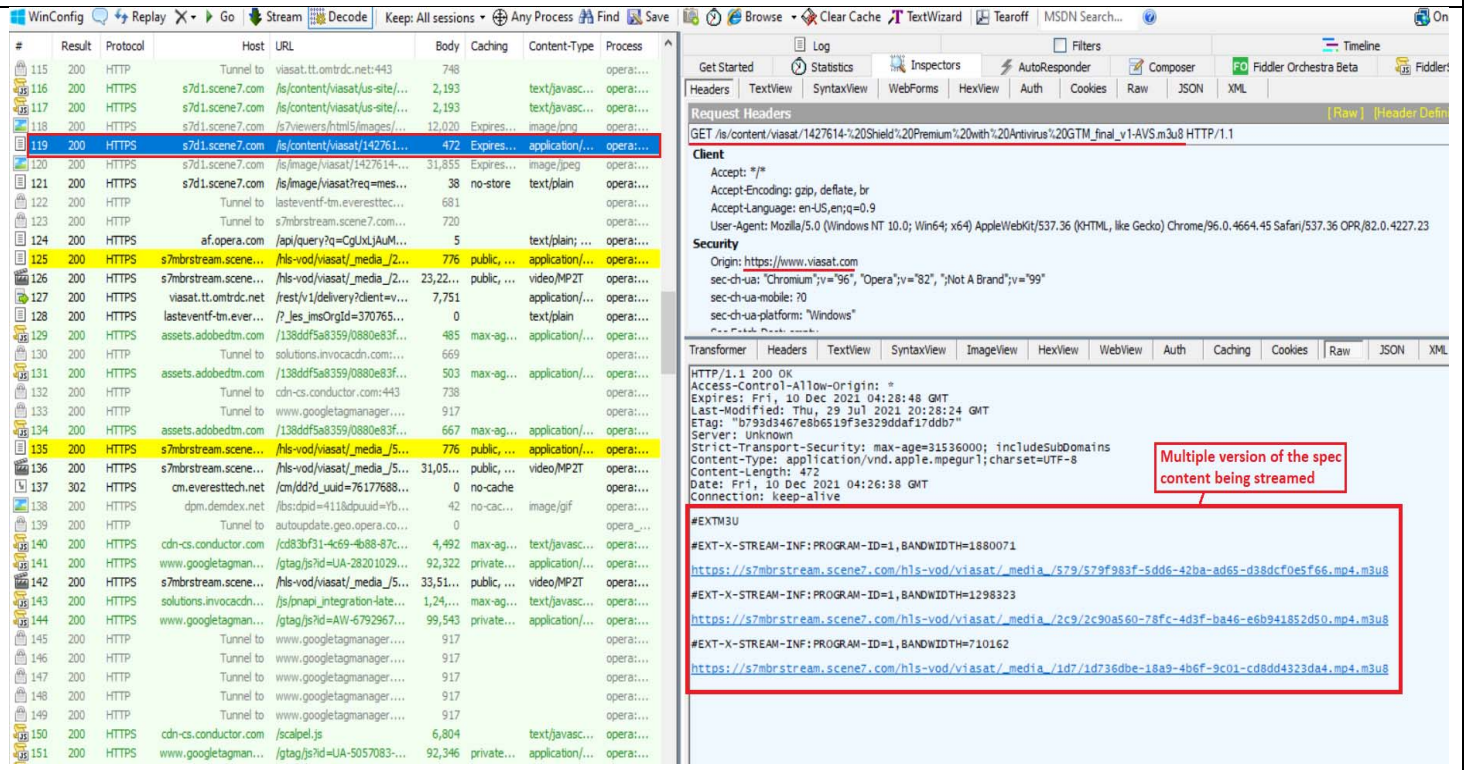
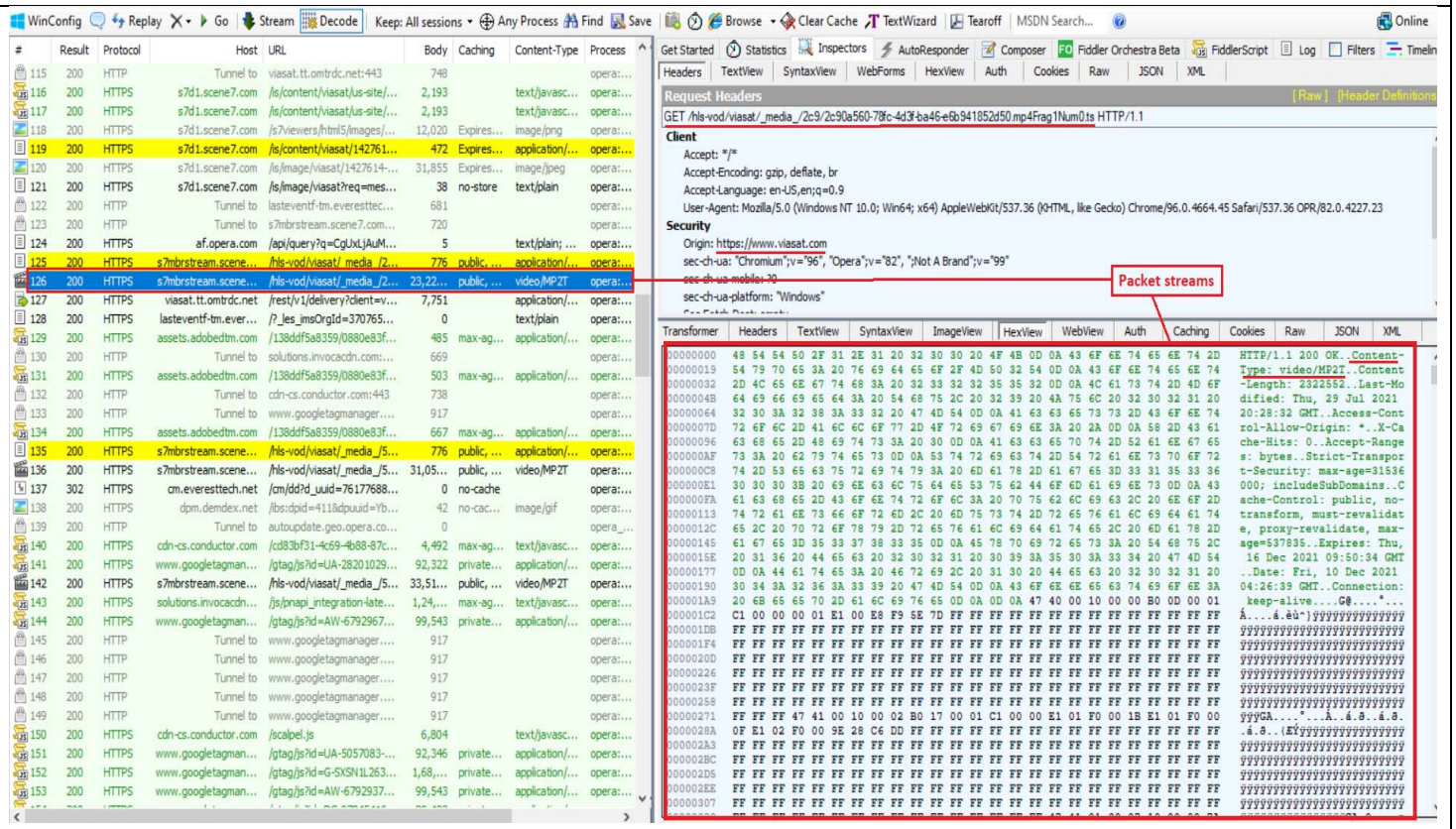
Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	

Source: Packet capture by Fiddler tool

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	

Source: Packet capture by Fiddler tool

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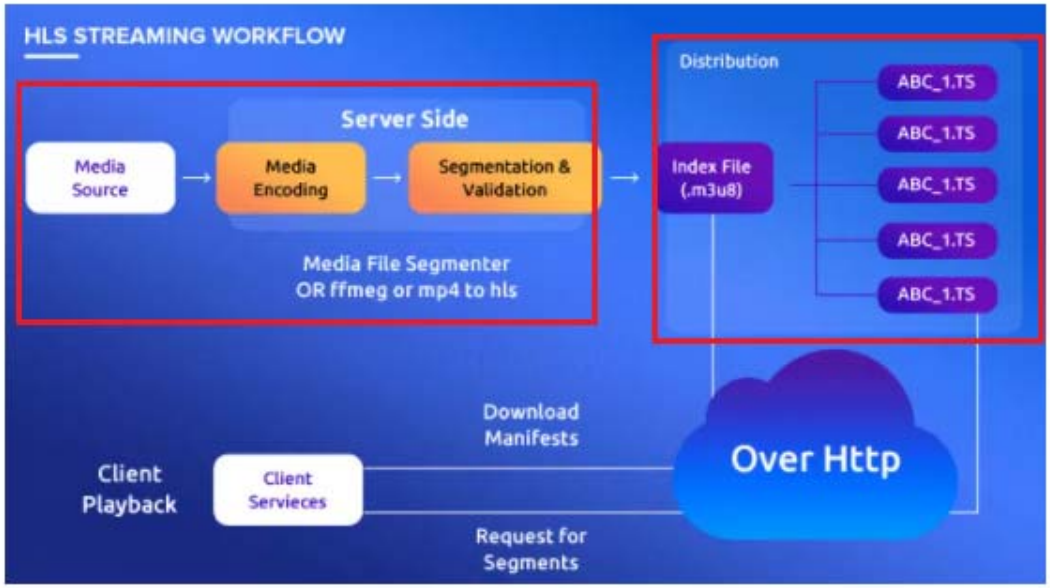
Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	 https://martech.zone/http-live-streaming-player-features/

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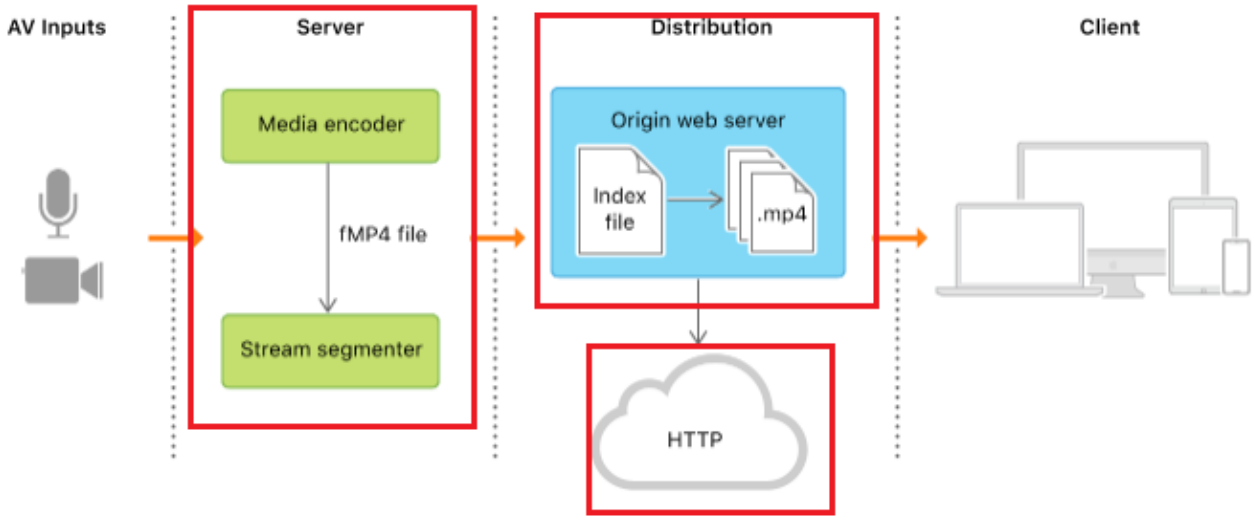
HLS supports the following:

- Live broadcasts and prerecorded content (video on demand, or *VOD*)
- Multiple alternate streams at different bit rates
- Intelligent switching of streams in response to network bandwidth changes
- Media encryption and user authentication

The following figure shows the components of an HTTP Live Stream.



https://developer.apple.com/documentation/http_live_streaming

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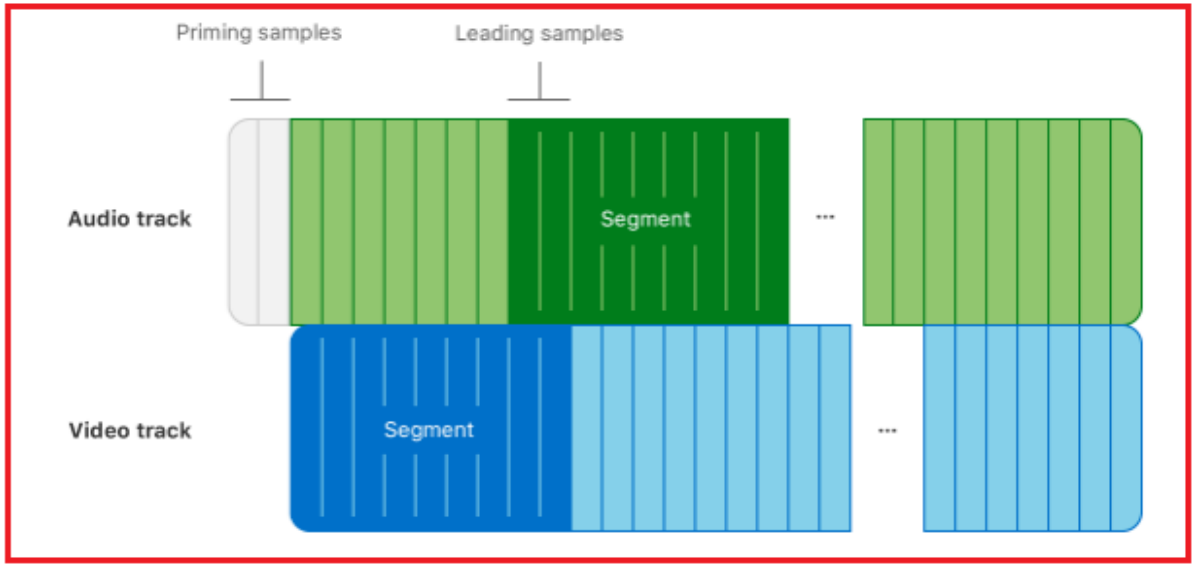
	AAC audio processing requires a small amount of leading "throw-away" audio to prime the encoder and initialize internal tables. This small amount of audio results from *encoder delay* which happens during encoding to produce properly formed, encoded audio packets, and its duration is commonly referred to as the *priming duration*. This audio needs to occur before the first frame of video; otherwise, there will be no audio for the first few frames of video.  The audio sample rates are normally 44.1 kHz or 48 kHz. For more information, see the HTTP Live Streaming Specification and the HLS Authoring Specification for Apple Devices. https://developer.apple.com/documentation/http_live_streaming/preparing_audio_for_http_live_streaming

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	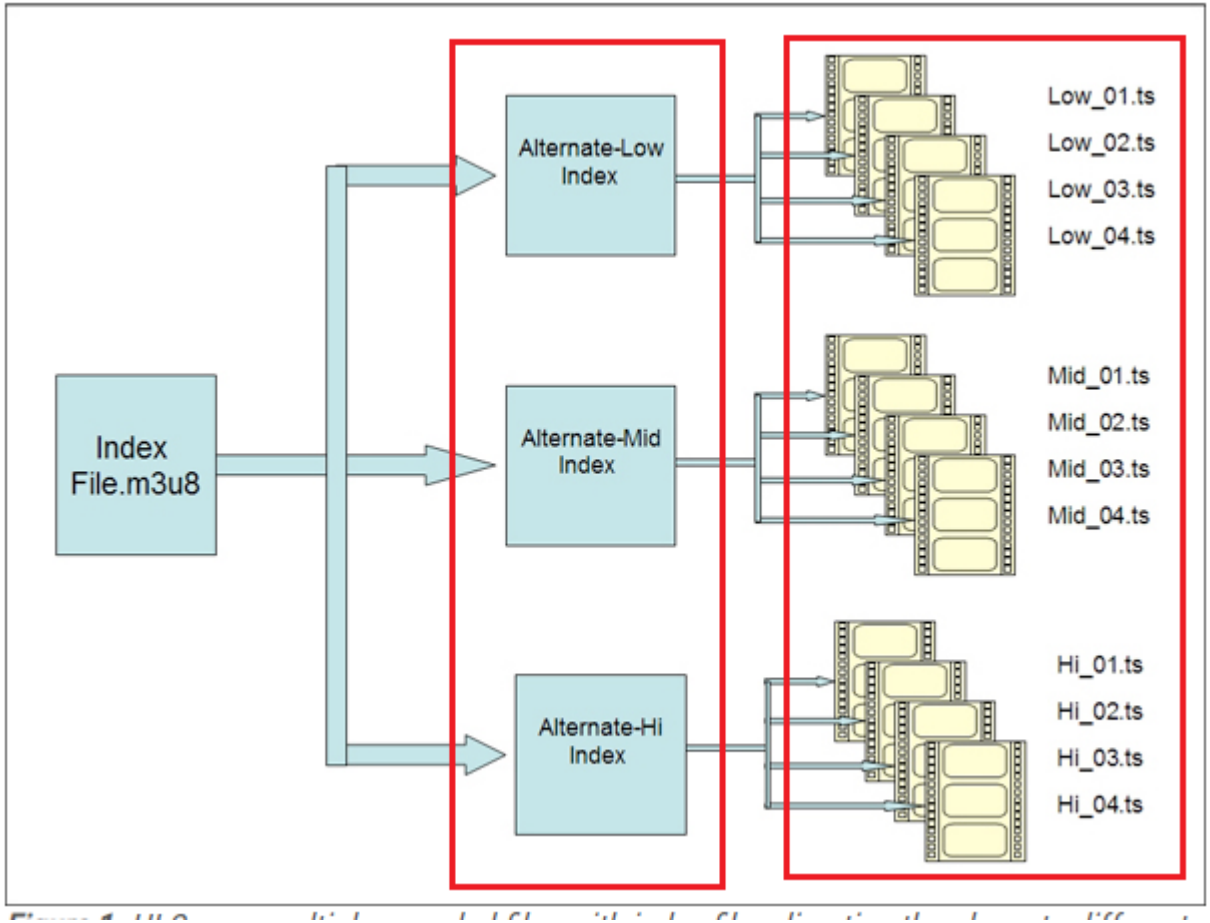 https://www.streamingmedia.com/Articles/Editorial/What-Is-.../What-Is-HLS-(HTTP-Live-Streaming)-78221.aspx?utm_source=related_articles&utm_medium=gutenberg&utm_campaign=editors_selection

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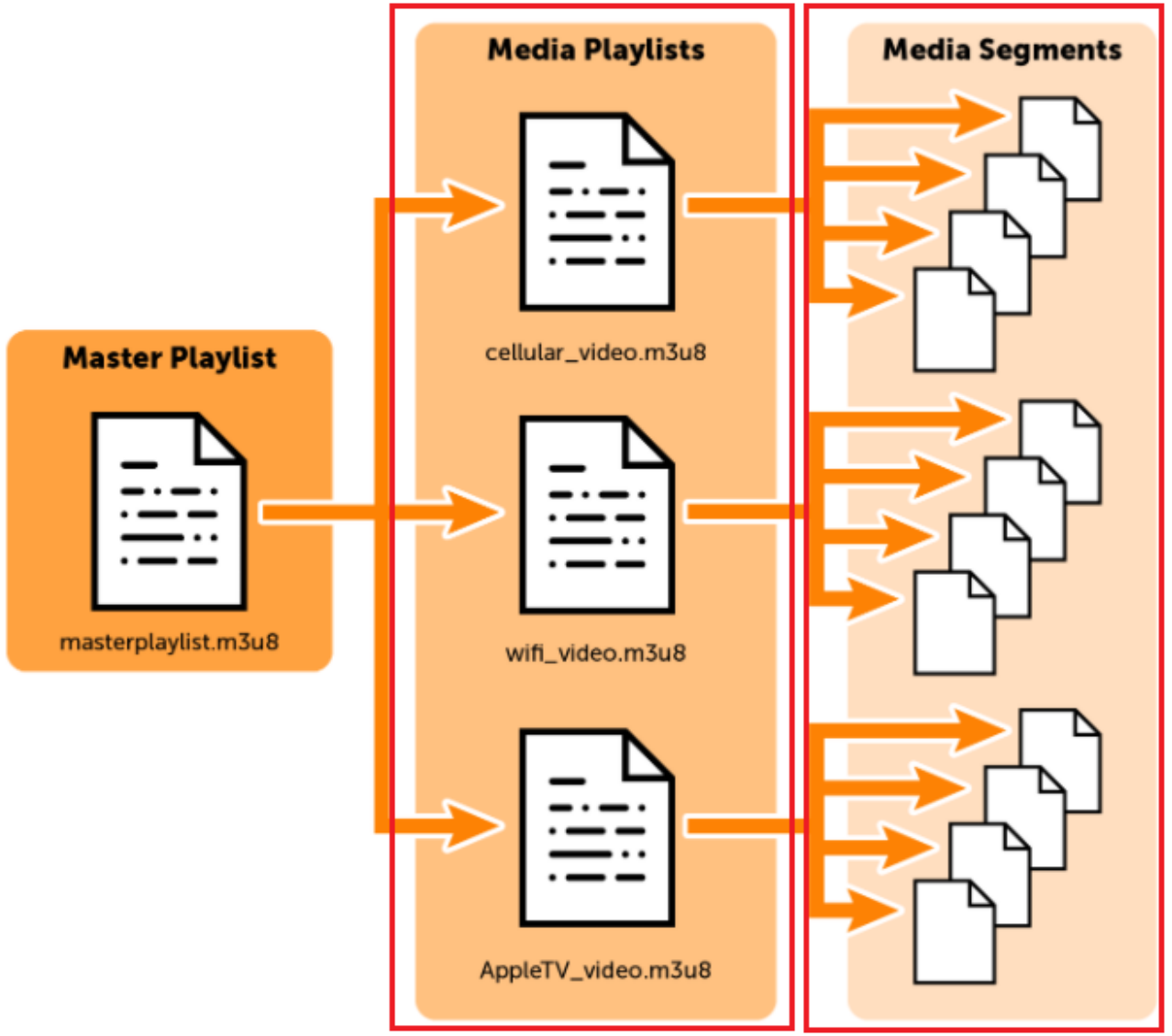

https://www.wowza.com/blog/hls-streaming-protocol

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7,848,328	ViaSat ("Accused Instrumentality")
	1. Introduction to HTTP Live Streaming HTTP Live Streaming provides a reliable, cost-effective means of delivering continuous and long-form video over the Internet. It allows a receiver to adapt the bit rate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality. It supports interstitial content boundaries. It provides a flexible framework for media encryption. It can efficiently offer multiple renditions of the same content, such as audio translations. It offers compatibility with large-scale HTTP caching infrastructure to support delivery to large audiences. https://datatracker.ietf.org/doc/html/rfc8216#section-1 **2. Overview** A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist. A Playlist is either a Media Playlist or a Master Playlist. Both are UTF-8 text files containing URIs and descriptive tags. A Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation. https://datatracker.ietf.org/doc/html/rfc8216

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	`#EXTM3U`
	`#EXT-X-TARGETDURATION:10`
	
	`#EXTINF:9.009,`
	`http://media.example.com/first.ts`
	`#EXTINF:9.009,`
	`http://media.example.com/second.ts`
	`#EXTINF:3.003,`
	`http://media.example.com/third.ts`
	
	The first line is the format identifier tag #EXTM3U. The line containing #EXT-X-TARGETDURATION says that all Media Segments will be 10 seconds long or less. Then, three Media Segments are declared. The first and second are 9.009 seconds long; the third is 3.003 seconds.
	
	https://datatracker.ietf.org/doc/html/rfc8216

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	A more complex presentation can be described by a Master Playlist. A Master Playlist provides a set of Variant Streams, each of which describes a different version of the same content. A Variant Stream includes a Media Playlist that specifies media encoded at a particular bit rate, in a particular format, and at a particular resolution for media containing video. A Variant Stream can also specify a set of Renditions. Renditions are alternate versions of the content, such as audio produced in different languages or video recorded from different camera angles. Clients should switch between different Variant Streams to adapt to network conditions. Clients should choose Renditions based on user preferences. https://datatracker.ietf.org/doc/html/rfc8216

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	Media Segments A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range. The duration of each Media Segment is indicated in the Media Playlist by its EXTINF tag (Section 4.3.2.1). Each segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one. Each Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted. The only exceptions are the first Media Segment ever to appear in a Media Playlist and Media Segments that are explicitly signaled as discontinuities (Section 4.3.2.3). Unmarked media discontinuities can trigger playback errors. https://datatracker.ietf.org/doc/html/rfc8216

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	3.2. MPEG-2 Transport Streams MPEG-2 Transport Streams are specified by [ISO_13818]. The Media Initialization Section of an MPEG-2 Transport Stream Segment is a Program Association Table (PAT) followed by a Program Map Table (PMT). Transport Stream Segments MUST contain a single MPEG-2 Program; playback of Multi-Program Transport Streams is not defined. Each Transport Stream Segment MUST contain a PAT and a PMT, or have an EXT-X-MAP tag (Section 4.3.2.5) applied to it. The first two Transport Stream packets in a Segment without an EXT-X-MAP tag SHOULD be a PAT and a PMT. https://datatracker.ietf.org/doc/html/rfc8216

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	3.4. Packed Audio A Packed Audio Segment contains encoded audio samples and ID3 tags that are simply packed together with minimal framing and no per-sample timestamps. Supported Packed Audio formats are Advanced Audio Coding (AAC) with Audio Data Transport Stream (ADTS) framing [ISO_13818_7], MP3 [ISO_13818_3], AC-3 [AC_3], and Enhanced AC-3 [AC_3]. A Packed Audio Segment has no Media Initialization Section. Each Packed Audio Segment MUST signal the timestamp of its first sample with an ID3 Private frame (PRIV) tag [ID3] at the beginning of the segment. The ID3 PRIV owner identifier MUST be "com.apple.streaming.transportStreamTimestamp". The ID3 payload MUST be a 33-bit MPEG-2 Program Elementary Stream timestamp expressed as a big-endian eight-octet number, with the upper 31 bits set to zero. Clients SHOULD NOT play Packed Audio Segments without this ID3 tag. https://datatracker.ietf.org/doc/html/rfc8216

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	3.5. WebVTT A WebVTT Segment is a section of a WebVTT [WebVTT] file. WebVTT Segments carry subtitles. The Media Initialization Section of a WebVTT Segment is the WebVTT header. Each WebVTT Segment MUST contain all subtitle cues that are intended to be displayed during the period indicated by the segment EXTINF duration. The start time offset and end time offset of each cue MUST indicate the total display time for that cue, even if part of the cue time range is outside the Segment period. A WebVTT Segment MAY contain no cues; this indicates that no subtitles are to be displayed during that period. https://datatracker.ietf.org/doc/html/rfc8216

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	In order to synchronize timestamps between audio/video and subtitles, an X-TIMESTAMP-MAP metadata header SHOULD be added to each WebVTT header. This header maps WebVTT cue timestamps to MPEG-2 (PES) timestamps in other Renditions of the Variant Stream. Its format is: X-TIMESTAMP-MAP=LOCAL:<cue time>,MPEGTS:<MPEG-2 time> e.g., X-TIMESTAMP-MAP=LOCAL:00:00:00.000,MPEGTS:900000 The cue timestamp in the LOCAL attribute MAY fall outside the range of time covered by the segment. If a WebVTT segment does not have the X-TIMESTAMP-MAP, the client MUST assume that the WebVTT cue time of 0 maps to an MPEG-2 timestamp of 0. When synchronizing WebVTT with PES timestamps, clients SHOULD account for cases where the 33-bit PES timestamps have wrapped and the WebVTT cue times have not. https://datatracker.ietf.org/doc/html/rfc8216

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	4.3.2. Media Segment Tags Each Media Segment is specified by a series of Media Segment tags followed by a URI. Some Media Segment tags apply to just the next segment; others apply to all subsequent segments until another instance of the same tag. A Media Segment tag MUST NOT appear in a Master Playlist. Clients MUST fail to parse Playlists that contain both Media Segment tags and Master Playlist tags (Section 4.3.4). 4.3.2.1. EXTINF The EXTINF tag specifies the duration of a Media Segment. It applies only to the next Media Segment. This tag is REQUIRED for each Media Segment. Its format is: #EXTINF:<duration>,[<title>] https://datatracker.ietf.org/doc/html/rfc8216

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	4.3.2.7. EXT-X-DATERANGE The EXT-X-DATERANGE tag associates a Date Range (i.e., a range of time defined by a starting and ending date) with a set of attribute/value pairs. Its format is: #EXT-X-DATERANGE:<attribute-list> where the defined attributes are: ID A quoted-string that uniquely identifies a Date Range in the Playlist. This attribute is REQUIRED. CLASS A client-defined quoted-string that specifies some set of attributes and their associated value semantics. All Date Ranges with the same CLASS attribute value MUST adhere to these semantics. This attribute is OPTIONAL. START-DATE A quoted-string containing the ISO-8601 date at which the Date Range begins. This attribute is REQUIRED. https://datatracker.ietf.org/doc/html/rfc8216

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4.3.4. Master Playlist Tags

Master Playlist tags define the Variant Streams, Renditions, and other global parameters of the presentation.

Master Playlist tags MUST NOT appear in a Media Playlist; clients MUST fail to parse any Playlist that contains both a Master Playlist tag and either a Media Playlist tag or a Media Segment tag.

4.3.4.1. EXT-X-MEDIA

The EXT-X-MEDIA tag is used to relate Media Playlists that contain alternative Renditions (Section 4.3.4.2.1) of the same content. For example, three EXT-X-MEDIA tags can be used to identify audio-only Media Playlists that contain English, French, and Spanish Renditions of the same presentation. Or, two EXT-X-MEDIA tags can be used to identify video-only Media Playlists that show two different camera angles.

Its format is:

#EXT-X-MEDIA:<attribute-list>

The following attributes are defined:

TYPE

The value is an enumerated-string; valid strings are AUDIO, VIDEO, SUBTITLES, and CLOSED-CAPTIONS. This attribute is REQUIRED.

https://datatracker.ietf.org/doc/html/rfc8216

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AUDIO

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is AUDIO. It indicates the set of audio Renditions that SHOULD be used when playing the presentation. See Section 4.3.4.2.1.

The AUDIO attribute is OPTIONAL.

VIDEO

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is VIDEO. It indicates the set of video Renditions that SHOULD be used when playing the presentation. See Section 4.3.4.2.1.

The VIDEO attribute is OPTIONAL.

s & May Informational [Page 31]

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SUBTITLES

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is SUBTITLES. It indicates the set of subtitle Renditions that can be used when playing the presentation. See Section 4.3.4.2.1.

The SUBTITLES attribute is OPTIONAL.

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	4.3.5. Media or Master Playlist Tags The tags in this section can appear in either Master Playlists or Media Playlists. If one of these tags appears in a Master Playlist, it SHOULD NOT appear in any Media Playlist referenced by that Master Playlist. A tag that appears in both MUST have the same value; otherwise, clients SHOULD ignore the value in the Media Playlist(s). These tags MUST NOT appear more than once in a Playlist. If a tag appears more than once, clients MUST fail to parse the Playlist. **4.3.5.1. EXT-X-INDEPENDENT-SEGMENTS** The EXT-X-INDEPENDENT-SEGMENTS tag indicates that all media samples in a Media Segment can be decoded without information from other segments. It applies to every Media Segment in the Playlist. Its format is: #EXT-X-INDEPENDENT-SEGMENTS Pantos & May Informational [Page 35] RFC 8216 HTTP Live Streaming August 2017 If the EXT-X-INDEPENDENT-SEGMENTS tag appears in a Master Playlist, it applies to every Media Segment in every Media Playlist in the Master Playlist. https://datatracker.ietf.org/doc/html/rfc8216

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6.2.1. General Server Responsibilities

The production of the source media is outside the scope of this document, which simply presumes a source of continuous encoded media containing the presentation.

The server MUST divide the source media into individual Media Segments whose duration is less than or equal to a constant target duration. Segments that are longer than the planned target duration can trigger playback stalls and other errors.

The server SHOULD attempt to divide the source media at points that support effective decode of individual Media Segments, e.g., on packet and key frame boundaries.

The server MUST create a URI for every Media Segment that enables its clients to obtain the segment data. If a server supports partial loading of resources (e.g., via HTTP Range requests), it MAY specify segments as sub-ranges of larger resources using the EXT-X-BYTERANGE tag.

https://datatracker.ietf.org/doc/html/rfc8216

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	6.2.4. Providing Variant Streams A server MAY offer multiple Media Playlist files to provide different encodings of the same presentation. If it does so, it SHOULD provide a Master Playlist file that lists each Variant Stream to allow clients to switch between encodings dynamically. Master Playlists describe regular Variant Streams with EXT-X-STREAM-INF tags and I-frame Variant Streams with EXT-X-I-FRAME-STREAM-INF tags. If an EXT-X-STREAM-INF tag or EXT-X-I-FRAME-STREAM-INF tag contains the CODECS attribute, the attribute value MUST include every media format [RFC6381] present in any Media Segment in any of the Renditions specified by the Variant Stream. https://datatracker.ietf.org/doc/html/rfc8216

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The server MUST meet the following constraints when producing Variant Streams in order to allow clients to switch between them seamlessly:

- Each Variant Stream MUST present the same content.

- Matching content in Variant Streams MUST have matching timestamps. This allows clients to synchronize the media.

- Matching content in Variant Streams MUST have matching Discontinuity Sequence Numbers (see Section 4.3.3.3).

- Each Media Playlist in each Variant Stream MUST have the same target duration. The only exceptions are SUBTITLES Renditions and Media Playlists containing an EXT-X-I-FRAMES-ONLY tag, which MAY have different target durations if they have an EXT-X-PLAYLIST-TYPE of VOD.

https://datatracker.ietf.org/doc/html/rfc8216

8.7. Master Playlist with Alternative Video

This example shows three different video Renditions (Main, Centerfield, and Dugout) and three different Variant Streams (low, mid, and high). In this example, clients that did not support the EXT-X-MEDIA tag and the VIDEO attribute of the EXT-X-STREAM-INF tag would only be able to play the video Rendition "Main".

Since the EXT-X-STREAM-INF tag has no AUDIO attribute, all video Renditions would be required to contain the audio.

https://datatracker.ietf.org/doc/html/rfc8216

Preliminary charts based on best available information

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In this example, the CODECS attributes have been condensed for space
A '\' is used to indicate that the tag continues on the following
line with whitespace removed:

#EXTM3U
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Main", \
   DEFAULT=YES,URI="low/main/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Centerfield", \
   DEFAULT=NO,URI="low/centerfield/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Dugout", \
   DEFAULT=NO,URI="low/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=1280000,CODECS="...",VIDEO="low"
low/main/audio-video.m3u8

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Main", \
   DEFAULT=YES,URI="mid/main/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Centerfield", \
   DEFAULT=NO,URI="mid/centerfield/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Dugout", \
   DEFAULT=NO,URI="mid/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=2560000,CODECS="...",VIDEO="mid"
mid/main/audio-video.m3u8

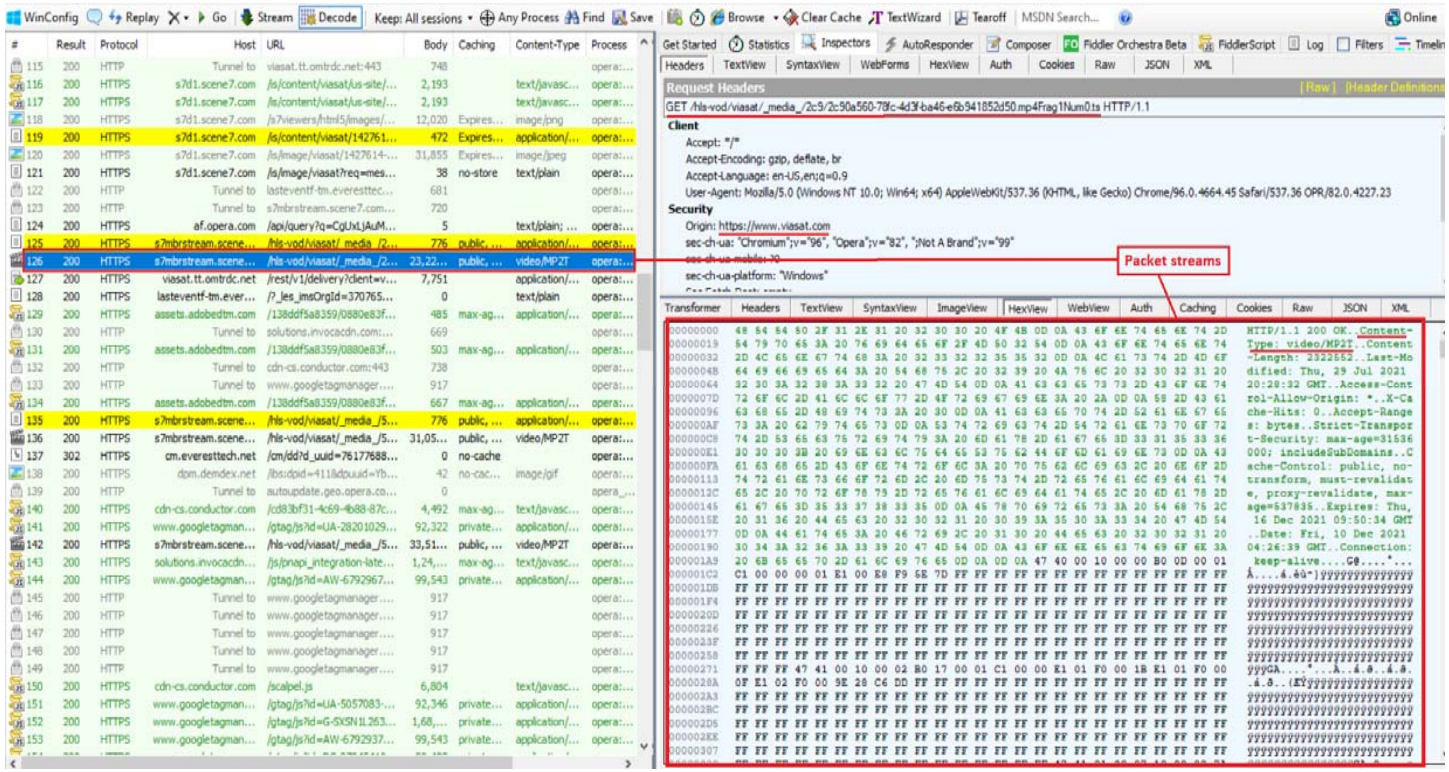
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Main", \
   DEFAULT=YES,URI="hi/main/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Centerfield", \
   DEFAULT=NO,URI="hi/centerfield/audio-video.m3u8"
#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Dugout", \
   DEFAULT=NO,URI="hi/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=7680000,CODECS="...",VIDEO="hi"
hi/main/audio-video.m3u8
```

https://datatracker.ietf.org/doc/html/rfc8216

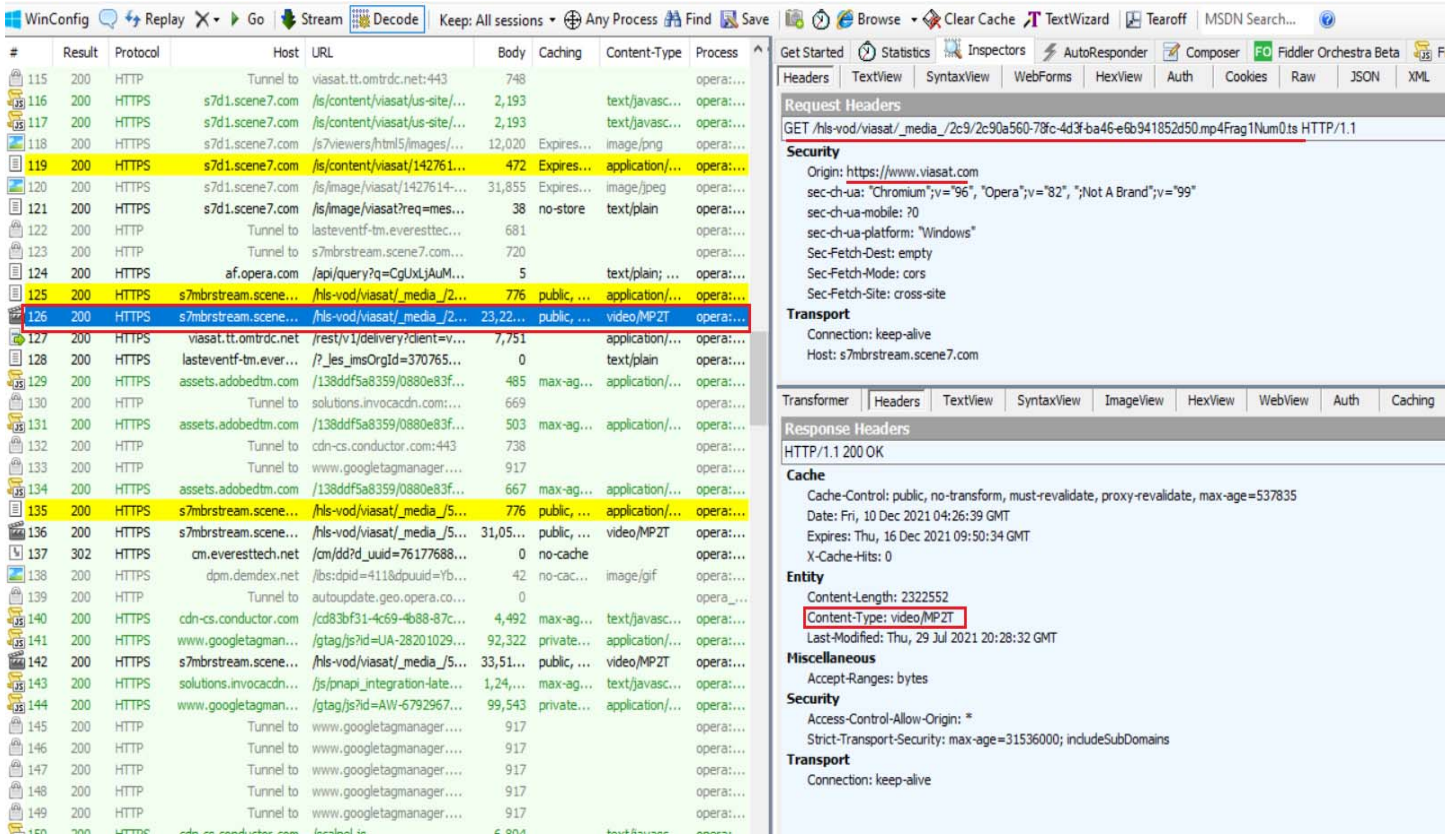
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
encapsulating each data stream of the plurality into a stream of packets according to a first communication protocol,	The accused standard discloses encapsulating each data stream (e.g., media streams such as audio, video, captions, etc.) of the plurality into a stream of packets (e.g., index file m3u8 data packets) according to a first communication protocol (e.g., Transmission control protocol). As shown below, For HLS, MPEG-2 transport stream is used to encapsulate the data stream (e.g., media streams such as audio, video, captions, etc.) using first communication protocol (e.g. TCP). 

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	Source: Packet capture by Fiddler tool  *Source: Packet capture by Fiddler tool*

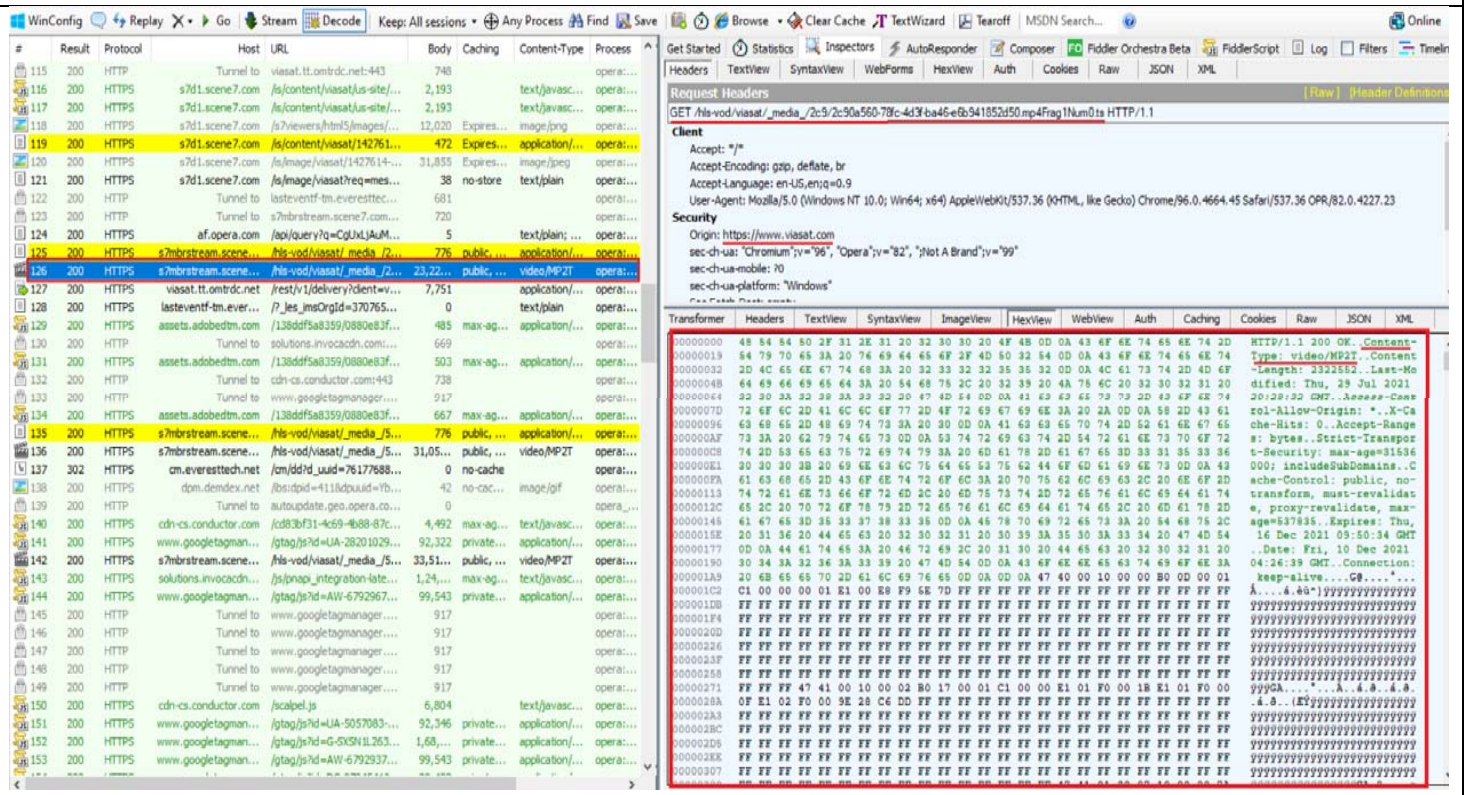
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	 *Source: Packet capture by Fiddler tool*

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	

Source: Packet capture by Fiddler tool

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	Encode MPEG-2 Transport Stream Segments MPEG-2 transport streams create an arbitrary timestamp when encoding media, using an 33-bit clock that rolls over every 26 hours. For example, if your video starts at the two-hour mark, your audio starts at two hours plus the time for the leading audio. Therefore, a segment of audio that's paired with a segment of video starting at the two-hour mark needs audio that starts at the two-hour mark minus the priming duration. This additional segment ensures the first frame of video plays synchronously with the audio. **Encode Fragmented MPEG-4 Segments** The MPEG-4 file format (ISO BMFF) carries the presumption that all track timelines begin with time zero, regardless of whether the timeline is divided into fragments. However, you can set the initial decode time of any fragment to an arbitrary value by means of the Track Fragment Base Media Decode Time Box (`tfdt`). Use this box to permit the alignment of the audio timeline with the video timeline that places the priming audio prior to the first video frame. Alternatively, starting with iOS 13.1 it's possible to utilize an Edit List Box (`elst`) within the Track Box (`trak`) in order to place the duration of the priming audio prior to time 0. This permits a natural alignment of other tracks with audio at time 0. The edit list needs to have a single entry in which the value of `media_start` is equivalent to the audio priming duration and the value of `segment_duration` is 0. This is the recommended approach for time alignment for the Common Media Application Format (CMAF).

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")

https://developer.apple.com/documentation/http_live_streaming/preparing_audio_for_http_live_streaming

Does HLS use TCP or UDP as its transport protocol?

TCP and UDP are transport protocols, meaning they are responsible for delivering content over the Internet. TCP tends to deliver data more reliably than UDP, but the latter is much faster, even though some data may be lost in transit.

Because UDP is faster, some streaming protocols use UDP instead of TCP. HLS, however, uses TCP. This is for several reasons:

1. HLS is over HTTP, and the HTTP protocol is built for use with TCP (with some exceptions).

2. The modern Internet is more reliable and more efficient than it was when streaming was first developed. In many parts of the world today, user connectivity has vastly improved, especially for mobile connections. As a result, users have enough bandwidth to support the delivery of every video frame.

3. Adaptive bitrate streaming helps compensate for the potentially slower data delivery of TCP.

https://www.cloudflare.com/learning/video/what-is-http-live-streaming/

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	A URI in a Playlist, whether it is a URI line or part of a tag, MAY be relative. Any relative URI is considered to be relative to the URI of the Playlist that contains it. The duration of a Media Playlist is the sum of the durations of the Media Segments within it. The segment bit rate of a Media Segment is the size of the Media Segment divided by its EXTINF duration (Section 4.3.2.1). Note that this includes container overhead but does not include overhead imposed by the delivery system, such as HTTP, TCP, or IP headers. The peak segment bit rate of a Media Playlist is the largest bit rate of any contiguous set of segments whose total duration is between 0.5 and 1.5 times the target duration. The bit rate of a set is calculated by dividing the sum of the segment sizes by the sum of the segment durations. https://datatracker.ietf.org/doc/html/rfc8216#section-1
wherein, as to each of the packet streams, the packets have a value in a common field identifying the component mapped to the data	The accused standard discloses wherein, as to each of the packet streams (e.g., m3u8 data packet stream), the packets have a value (e.g., audio/video type, group id, etc.) in a common field identifying the component mapped to the data stream (e.g., media streams such as audio, video, captions, etc.) encapsulated by the packet stream (e.g., m3u8 data packet stream). As shown below, the common field shows "type: video"

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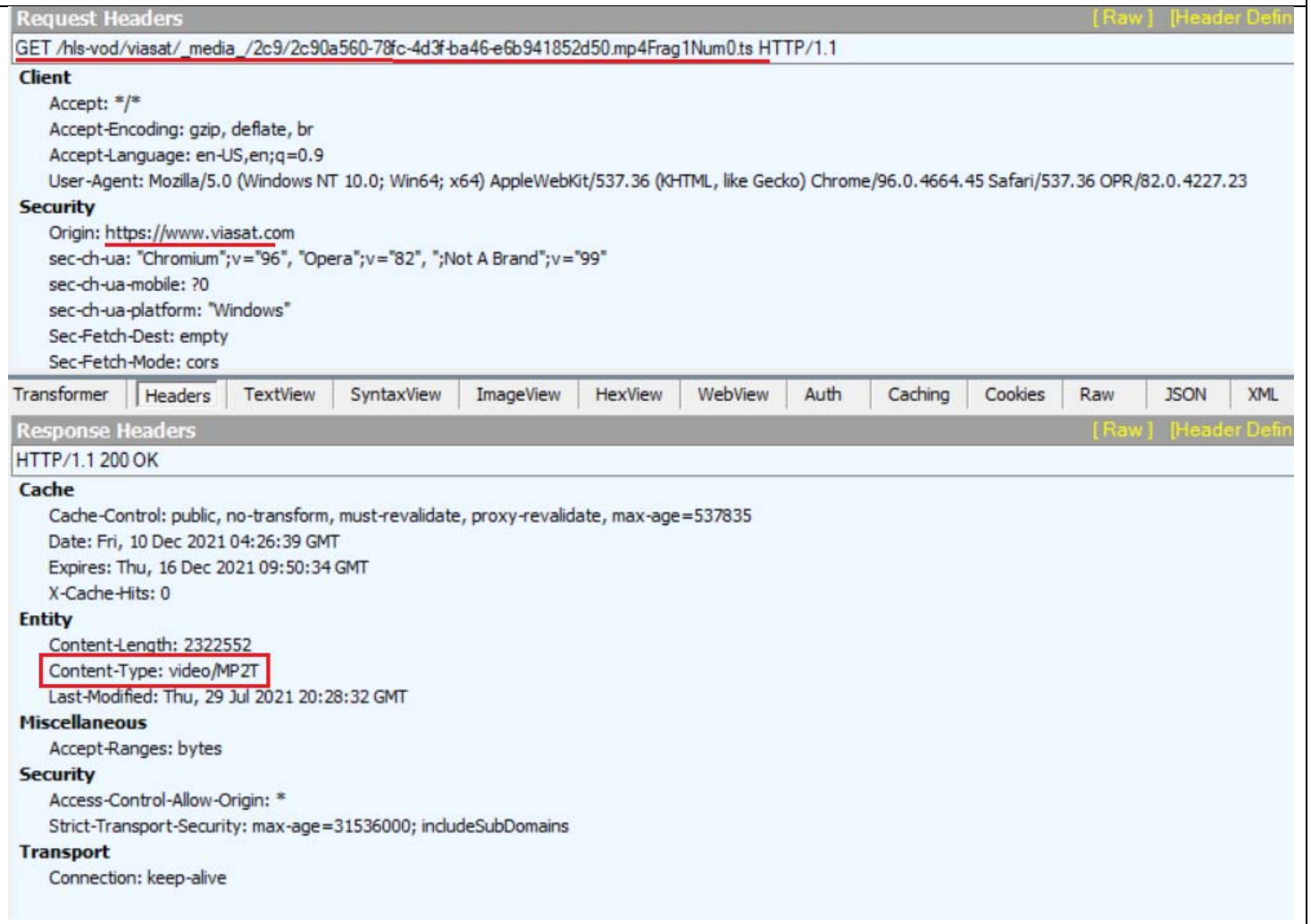
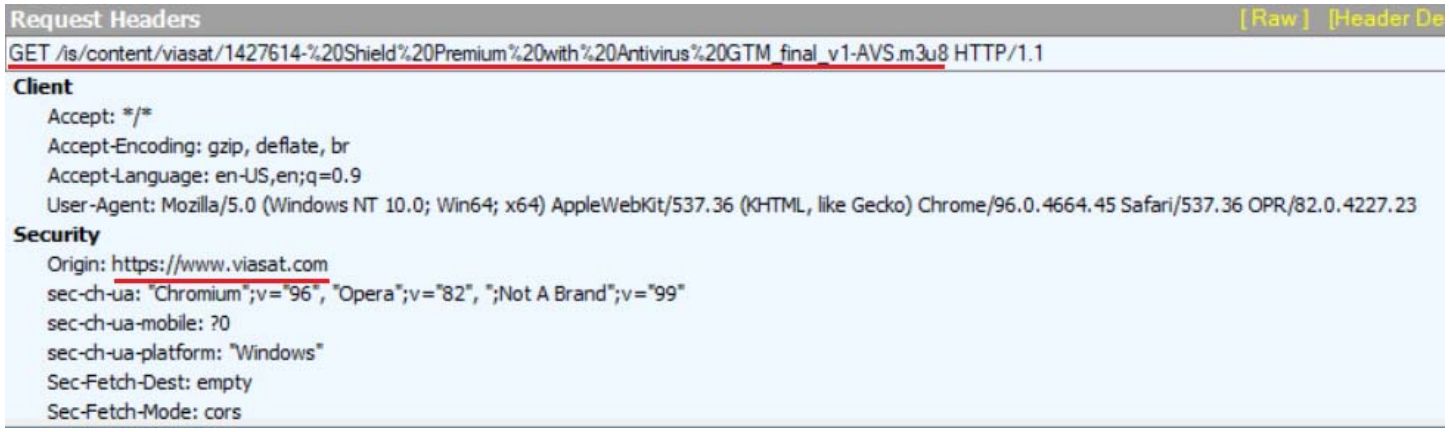
Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
stream encapsulated by the packet stream;	

Source: Packet capture by Fiddler tool

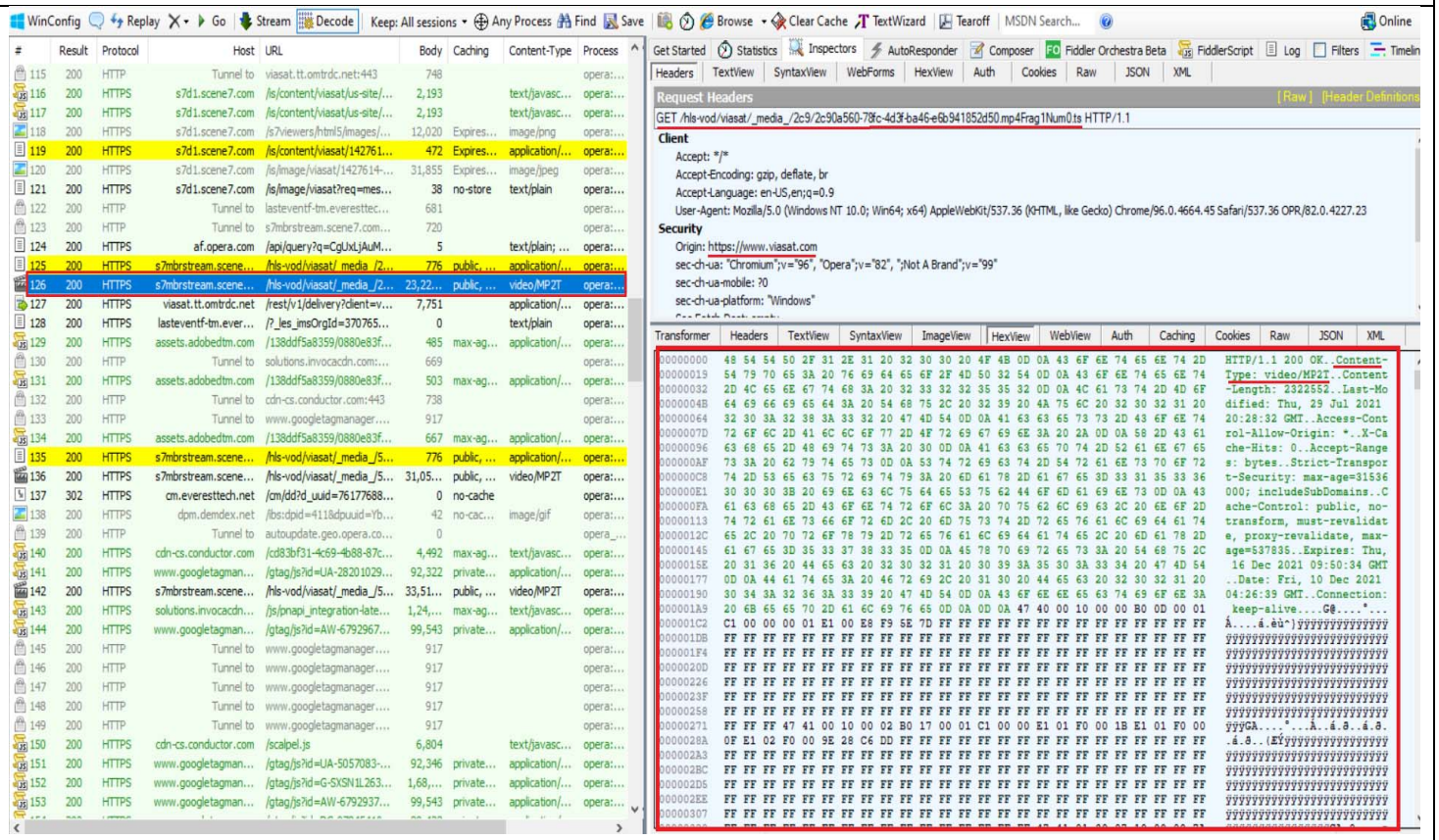
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	 *Source: Packet capture by Fiddler tool*

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	

Source: Packet capture by Fiddler tool

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Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")

#EXT-X-MEDIA:<attribute-list>

The following attributes are defined:

TYPE

The value is an enumerated-string; valid strings are AUDIO, VIDEO, SUBTITLES, and CLOSED-CAPTIONS. This attribute is REQUIRED.

Typically, closed-caption [CEA608] media is carried in the video stream. Therefore, an EXT-X-MEDIA tag with TYPE of CLOSED-CAPTIONS does not specify a Rendition; the closed-caption media is present in the Media Segments of every video Rendition.

URI

The value is a quoted-string containing a URI that identifies the Media Playlist file. This attribute is OPTIONAL; see Section 4.3.4.2.1. If the TYPE is CLOSED-CAPTIONS, the URI attribute MUST NOT be present.

GROUP-ID

The value is a quoted-string that specifies the group to which the Rendition belongs. See Section 4.3.4.1.1. This attribute is REQUIRED.

https://datatracker.ietf.org/doc/html/rfc8216

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	**ViaSat ("Accused Instrumentality")**

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7,848,328	ViaSat ("Accused Instrumentality")
	Encode MPEG-2 Transport Stream Segments MPEG-2 transport streams create an arbitrary timestamp when encoding media, using an 33-bit clock that rolls over every 26 hours. For example, if your video starts at the two-hour mark, your audio starts at two hours plus the time for the leading audio. Therefore, a segment of audio that's paired with a segment of video starting at the two-hour mark needs audio that starts at the two-hour mark minus the priming duration. This additional segment ensures the first frame of video plays synchronously with the audio. **Encode Fragmented MPEG-4 Segments** The MPEG-4 file format (ISO BMFF) carries the presumption that all track timelines begin with time zero, regardless of whether the timeline is divided into fragments. However, you can set the initial decode time of any fragment to an arbitrary value by means of the Track Fragment Base Media Decode Time Box (`tfdt`). Use this box to permit the alignment of the audio timeline with the video timeline that places the priming audio prior to the first video frame. Alternatively, starting with iOS 13.1 it's possible to utilize an Edit List Box (`elst`) within the Track Box (`trak`) in order to place the duration of the priming audio prior to time 0. This permits a natural alignment of other tracks with audio at time 0. The edit list needs to have a single entry in which the value of `media_start` is equivalent to the audio priming duration and the value of `segment_duration` is 0. This is the recommended approach for time alignment for the Common Media Application Format (CMAF).

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Preliminary charts based on best available information

7,848,328	**ViaSat ("Accused Instrumentality")**
	https://developer.apple.com/documentation/http_live_streaming/preparing_audio_for_http_live_streaming

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Preliminary charts based on best available information

4.3.4. Master Playlist Tags

Master Playlist tags define the Variant Streams, Renditions, and other global parameters of the presentation.

Master Playlist tags MUST NOT appear in a Media Playlist; clients MUST fail to parse any Playlist that contains both a Master Playlist tag and either a Media Playlist tag or a Media Segment tag.

4.3.4.1. EXT-X-MEDIA

The EXT-X-MEDIA tag is used to relate Media Playlists that contain alternative Renditions (Section 4.3.4.2.1) of the same content. For example, three EXT-X-MEDIA tags can be used to identify audio-only Media Playlists that contain English, French, and Spanish Renditions of the same presentation. Or, two EXT-X-MEDIA tags can be used to identify video-only Media Playlists that show two different camera angles.

Its format is:

#EXT-X-MEDIA:<attribute-list>

The following attributes are defined:

TYPE

The value is an enumerated-string; valid strings are AUDIO, VIDEO, SUBTITLES, and CLOSED-CAPTIONS. This attribute is REQUIRED.

https://datatracker.ietf.org/doc/html/rfc8216

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7,848,328	ViaSat ("Accused Instrumentality")
	3.2. MPEG-2 Transport Streams MPEG-2 Transport Streams are specified by [ISO_13818]. The Media Initialization Section of an MPEG-2 Transport Stream Segment is a Program Association Table (PAT) followed by a Program Map Table (PMT). Transport Stream Segments MUST contain a single MPEG-2 Program; playback of Multi-Program Transport Streams is not defined. Each Transport Stream Segment MUST contain a PAT and a PMT, or have an EXT-X-MAP tag (Section 4.3.2.5) applied to it. The first two Transport Stream packets in a Segment without an EXT-X-MAP tag SHOULD be a PAT and a PMT. https://datatracker.ietf.org/doc/html/rfc8216

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7,848,328	ViaSat ("Accused Instrumentality")
	3.3. Fragmented MPEG-4 MPEG-4 Fragments are specified by the ISO Base Media File Format [ISOBMFF]. Unlike regular MPEG-4 files that have a Movie Box ('moov') that contains sample tables and a Media Data Box ('mdat') containing the corresponding samples, an MPEG-4 Fragment consists of a Movie Fragment Box ('moof') containing a subset of the sample table and a Media Data Box containing those samples. Use of MPEG-4 Fragments does require a Movie Box for initialization, but that Movie Box contains only non-sample-specific information such as track and sample descriptions. https://datatracker.ietf.org/doc/html/rfc8216

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7,848,328	ViaSat ("Accused Instrumentality")

URI

The value is a quoted-string containing a URI that identifies the Media Playlist file. This attribute is OPTIONAL; see Section 4.3.4.2.1. If the TYPE is CLOSED-CAPTIONS, the URI attribute MUST NOT be present.

:os & May Informational [Page 25]

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GROUP-ID

The value is a quoted-string that specifies the group to which the Rendition belongs. See Section 4.3.4.1.1. This attribute is REQUIRED.

LANGUAGE

The value is a quoted-string containing one of the standard Tags for Identifying Languages [RFC5646], which identifies the primary language used in the Rendition. This attribute is OPTIONAL.

ASSOC-LANGUAGE

The value is a quoted-string containing a language tag [RFC5646] that identifies a language that is associated with the Rendition. An associated language is often used in a different role than the language specified by the LANGUAGE attribute (e.g., written versus

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7,848,328	**ViaSat ("Accused Instrumentality")**
	https://datatracker.ietf.org/doc/html/rfc8216

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Preliminary charts based on best available information

AUDIO

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is AUDIO. It indicates the set of audio Renditions that SHOULD be used when playing the presentation. See Section 4.3.4.2.1.

The AUDIO attribute is OPTIONAL.

VIDEO

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is VIDEO. It indicates the set of video Renditions that SHOULD be used when playing the presentation. See Section 4.3.4.2.1.

The VIDEO attribute is OPTIONAL.

s & May Informational [Page 31]

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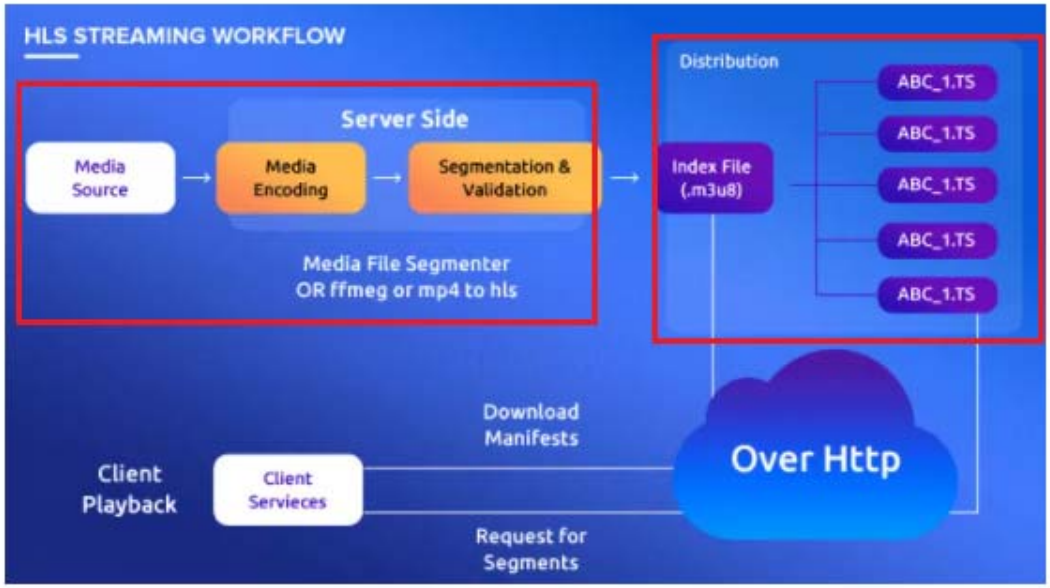
SUBTITLES

The value is a quoted-string. It MUST match the value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist whose TYPE attribute is SUBTITLES. It indicates the set of subtitle Renditions that can be used when playing the presentation. See Section 4.3.4.2.1.

The SUBTITLES attribute is OPTIONAL.

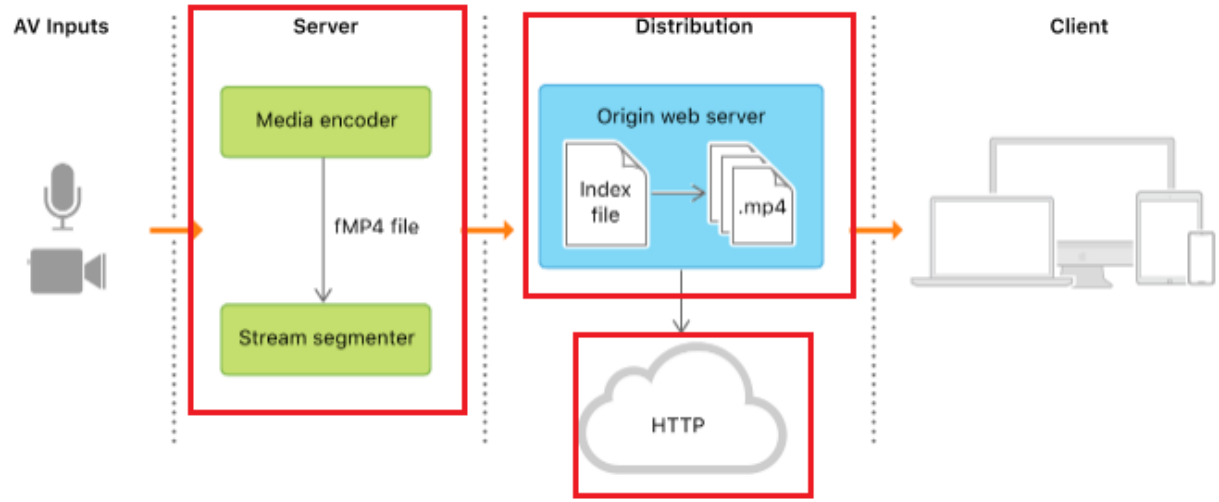
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

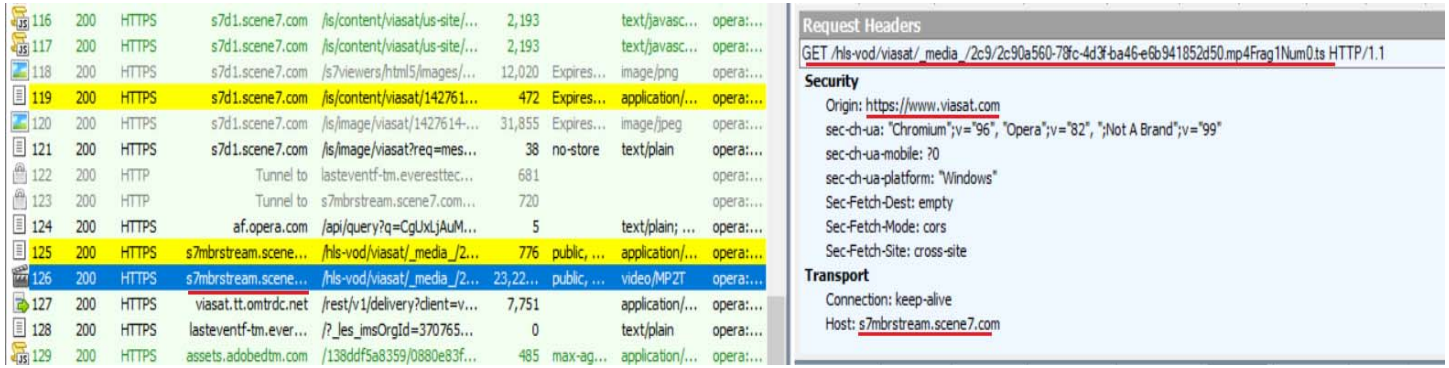
7,848,328	ViaSat ("Accused Instrumentality")
	https://datatracker.ietf.org/doc/html/rfc8216
and forwarding the packet streams for transmission in a transmission channel,	The accused standard discloses forwarding the packet streams (e.g., m3u8 data packet stream) for transmission in a transmission channel (e.g., wired/wireless transmission).  https://martech.zone/http-live-streaming-player-features/

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	HLS supports the following: • Live broadcasts and prerecorded content (video on demand, or *VOD*) • Multiple alternate streams at different bit rates • Intelligent switching of streams in response to network bandwidth changes • Media encryption and user authentication The following figure shows the components of an HTTP Live Stream.  https://developer.apple.com/documentation/http_live_streaming
and wherein the mapping further	The accused standard discloses wherein the mapping further comprises assigning a specific value (e.g., value corresponding to different media stream) to each component for a predefined field of a packet (e.g., segment info)

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
comprises assigning a specific value to each component for a predefined field of a packet according to a second communication protocol, the specific value distinguishing the component from other components, and	according to a second communication protocol (e.g., HTTP/Hypertext transfer protocol), the specific value (e.g., value corresponding to different media stream) distinguishing the component from other components. As shown below, the accused standard provides m3u8 index file with multiple media playlists. Each media playlist has many representations, wherein every representation has many segments, these segments contains media information of each conversion corresponding to that media playlist. The accused standard provides each segment having information related to a particular HTTP based uniform resource locator for getting a media stream from that particular address. For the video segment shown below, the base URL is https://s7mbrstream.scene7.com/ and the specific value is "hls-vod/viasat/_media_/2c9/2c90a560-78fc-4d3f-ba46-e6b941852d50.mp4Frag1Num0.ts" (http based).  *Source: Packet capture by Fiddler tool*

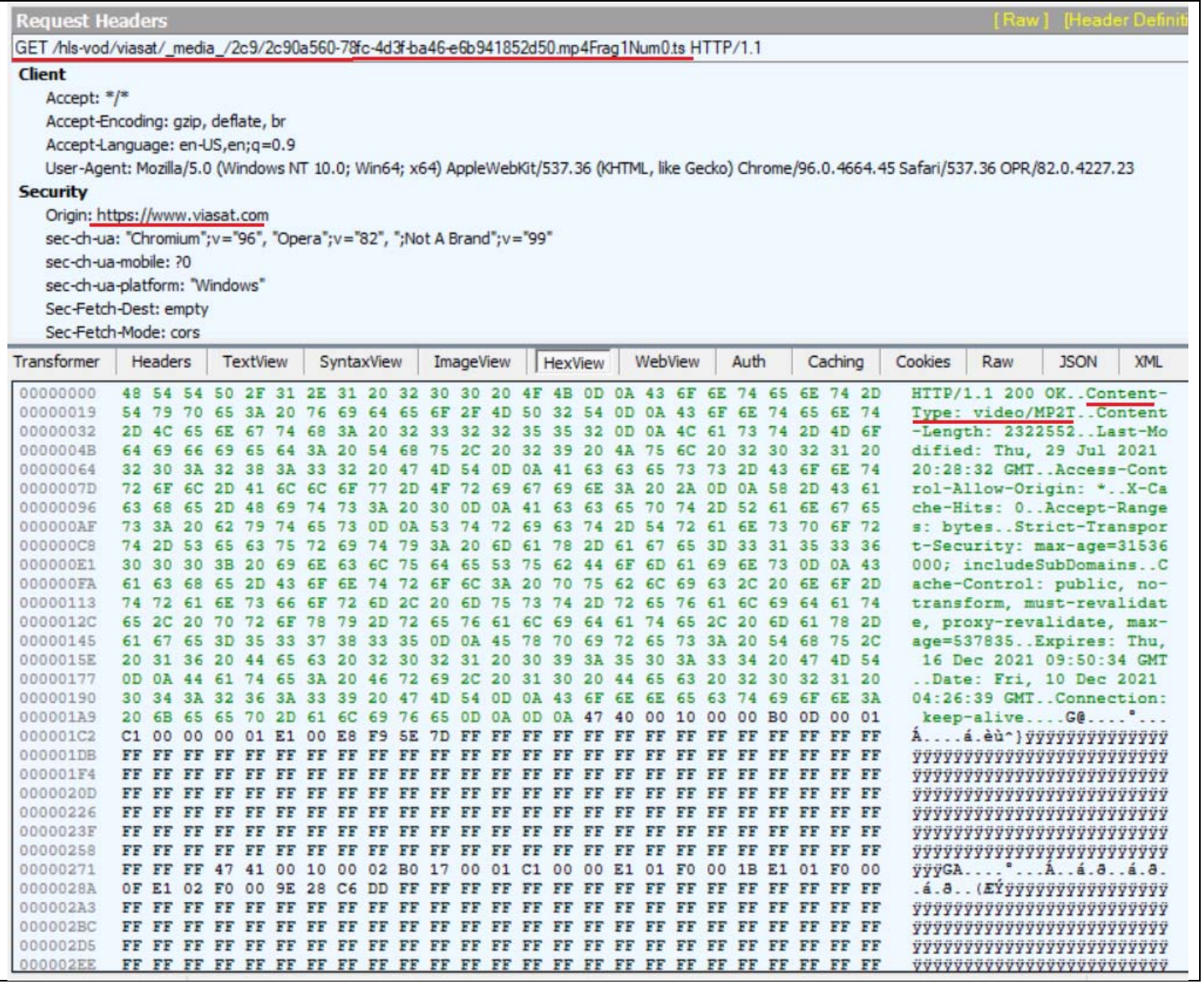
NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

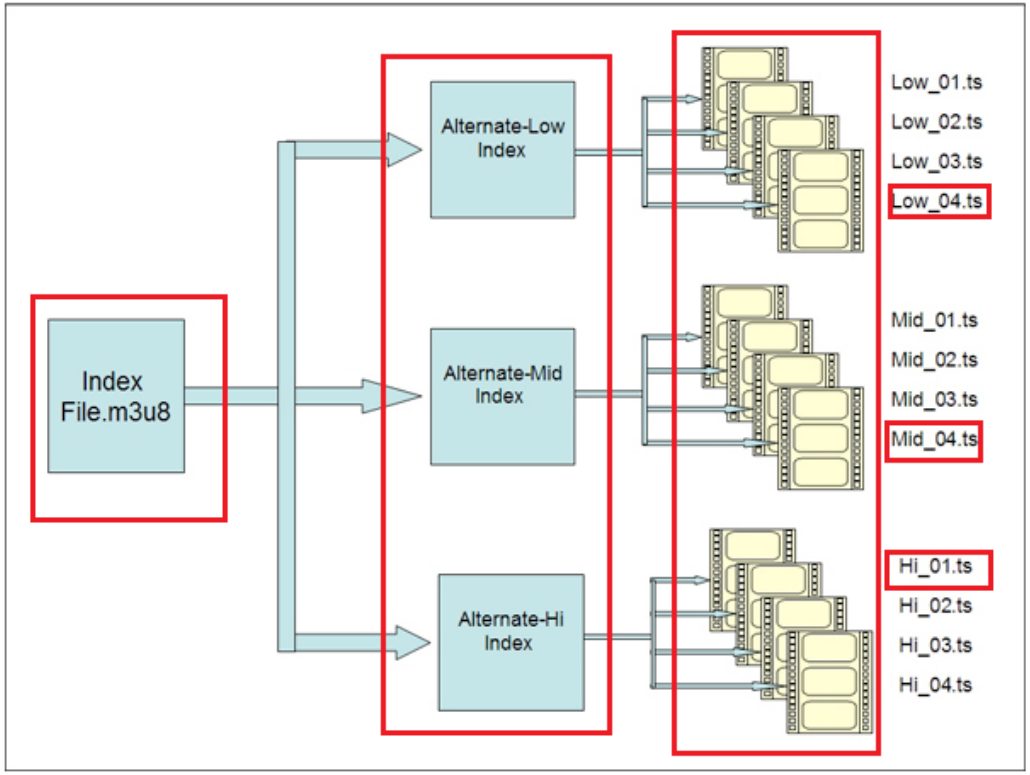
7,848,328	ViaSat ("Accused Instrumentality")
	 *Source: Packet capture by Fiddler tool*

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

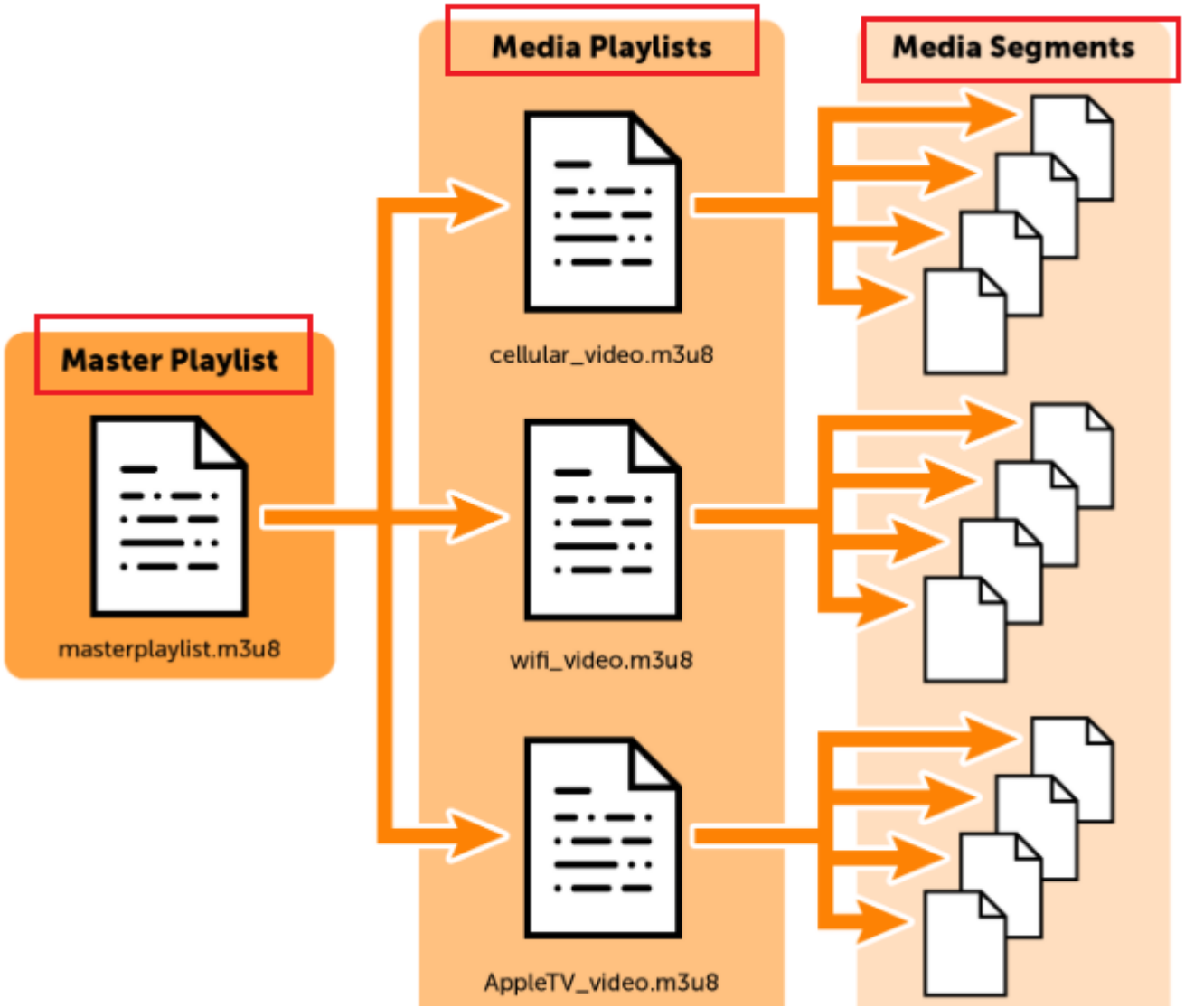
Preliminary charts based on best available information



Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	Source: Packet capture by Fiddler tool  ***Figure 1.*** *HLS uses multiple encoded files with index files directing the player to different streams and chunks of audio/video data within those streams.* https://www.streamingmedia.com/Articles/Editorial/What-Is-.../What-Is-HLS-(HTTP-Live-Streaming)-78221.aspx?utm_source=related_articles&utm_medium=gutenberg&utm_campaign=editors_selection

Preliminary charts based on best available information



https://www.wowza.com/blog/hls-streaming-protocol

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7,848,328	**ViaSat ("Accused Instrumentality")**

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7,848,328	ViaSat ("Accused Instrumentality")

8.3. Playlist with Encrypted Media Segments

```
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-MEDIA-SEQUENCE:7794
#EXT-X-TARGETDURATION:15

#EXT-X-KEY:METHOD=AES-128,URI="https://priv.example.com/key.php?r=52"

#EXTINF:2.833,
http://media.example.com/fileSequence52-A.ts
#EXTINF:15.0,
http://media.example.com/fileSequence52-B.ts
#EXTINF:13.333,
http://media.example.com/fileSequence52-C.ts

#EXT-X-KEY:METHOD=AES-128,URI="https://priv.example.com/key.php?r=53"

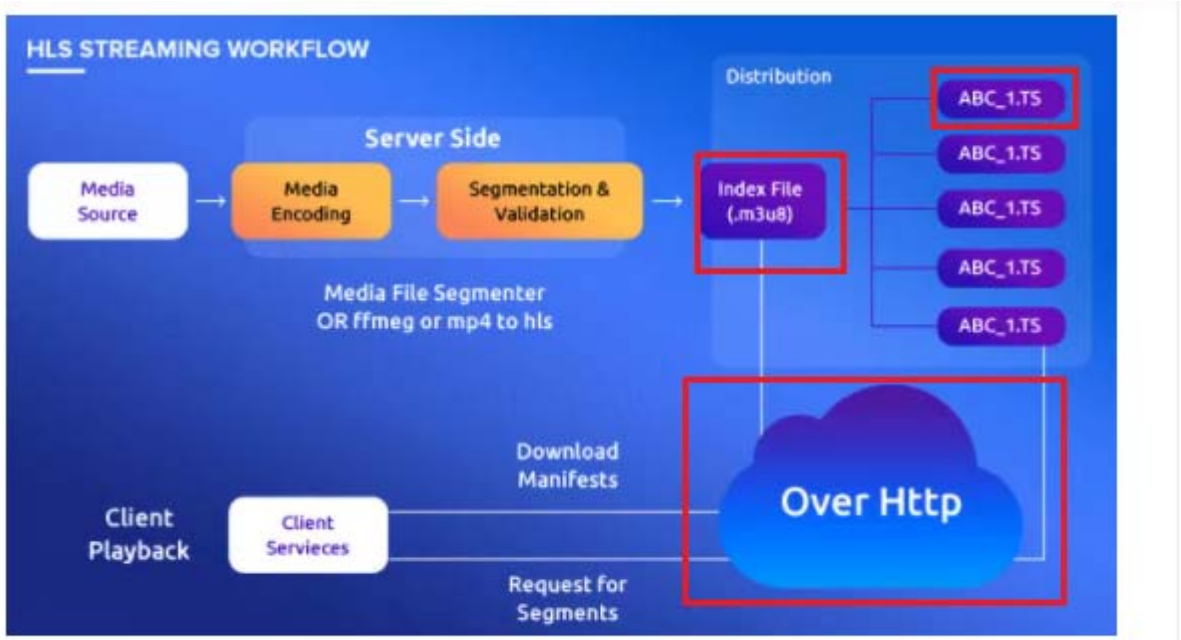
#EXTINF:15.0,
http://media.example.com/fileSequence53-A.ts
```

8.4. Master Playlist

```
#EXTM3U
#EXT-X-STREAM-INF:BANDWIDTH=1280000,AVERAGE-BANDWIDTH=1000000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=2560000,AVERAGE-BANDWIDTH=2000000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=7680000,AVERAGE-BANDWIDTH=6000000
http://example.com/hi.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"
http://example.com/audio-only.m3u8
```

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	https://datatracker.ietf.org/doc/html/rfc8216  https://martech.zone/http-live-streaming-player-features/
the encapsulating comprises encapsulating the packet streams according to one or more	The accused standard discloses encapsulating comprises encapsulating the packet streams (e.g., data packets in m3u8 file) according to one or more lower layer protocols without encapsulating the packet streams (e.g., data packets in m3u8) according to the second communication protocol (e.g. HTTP Protocol). Further as explained below, the packet streams are encapsulated according to one or more lower layer protocols (e.g., network layer/MAC layer/physical layer) of the device transmitting the packet streams. Since, the packet streams are obtained by TCP encapsulation of data streams and the HTTP protocol doesn't reside beneath the

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Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
lower layer protocols without encapsulating the packet streams according to the second communication protocol.	TCP layer, the further encapsulation doesn't comprise encapsulation using HTTP protocol (once TCP encapsulation has been executed). In any communication system, when a sender prepares data for sending from its physical interface (e.g., wired/wireless interface of the server/machine), the process of entire "data formulation" or "data construction" has multiple steps, all steps (if they are present) are associated with one layer of OSI model (it's a model which every communication system follows, some specification communication schemes may have lower number of layers (because multiple layers of OSI can be combined into one for those cases). Two lower level layers—data link layer and physical layers are invariably present in any communication system. They are the lowest two layers. They reside beneath the TCP layer. Data link layer ensure error free communication whereas the physical layer processes the data so that it can be sent using the actual medium of communication (e.g., modulation and formatting in wireless/wired communication system)

NIMITZ TECHNOLOGIES LLC CLAIM CHARTS RE PAT. 7,848,328

Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")

Does HLS use TCP or UDP as its transport protocol?

TCP and UDP are transport protocols, meaning they are responsible for delivering content over the Internet. TCP tends to deliver data more reliably than UDP, but the latter is much faster, even though some data may be lost in transit.

Because UDP is faster, some streaming protocols use UDP instead of TCP. HLS, however, uses TCP. This is for several reasons:

1. HLS is over HTTP, and the HTTP protocol is built for use with TCP (with some exceptions).

2. The modern Internet is more reliable and more efficient than it was when streaming was first developed. In many parts of the world today, user connectivity has vastly improved, especially for mobile connections. As a result, users have enough bandwidth to support the delivery of every video frame.

3. Adaptive bitrate streaming helps compensate for the potentially slower data delivery of TCP.

https://www.cloudflare.com/learning/video/what-is-http-live-streaming/

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Preliminary charts based on best available information

7,848,328	ViaSat ("Accused Instrumentality")
	HyperText Transfer Protocol (*HTTP*) The HyperText Transfer Protocol, or *HTTP*, must be the most widely used Application layer protocol in the world today. It forms the basis of what most people understand the Internet to be—the World Wide Web. Its purpose is to provide a lightweight protocol for the retrieval of HyperText Markup Language (*HTML*) and other documents from Web sites throughout the Internet. Each time you open a Web browser to surf the Internet, you are using *HTTP* over *TCP/IP*. *HTTP* was first ratified in the early 1990s and has been through three main iterations: • **HTTP/0.9:** A simplistic first implementation of the protocol that only supported the option to get a Web page. • **HTTP/1.0:** Ratified by the *IETF* as RFC 1945 in 1996. This version added many supplemental data fields, known as *headers* to the specification. This allowed for other information passing between the client and server, alongside the request and consequent page. • **HTTP/1.1:** Defined in RFC 2068 by the *IETF*, version 1.1 implemented a number of improvements over and above the 1.0 specification. One of the main improvements of 1.1 over 1.0 was the implementation of techniques such as persistent *TCP* connections, pipelining, and cache control to improve performance within *HTTP*-based applications. https://www.informit.com/articles/article.aspx?p=169578

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Upper and Lower layers further divide network architecture into seven different layers as below

- Application
- Presentation
- Session
- Transport
- Network, Data-link
- Physical layers

HTTP resides at application layer

Network Layers Diagram

https://www.guru99.com/layers-of-osi-model.html

https://www.cloudflare.com/learning/ddos/glossary/open-systems-interconnection-model-osi/

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